

## EWEA Technology Workshop #2: Analysis of Operating Wind Farms: Learning the Lessons from Operational Sites

### Programme

**Monday 2 July 2012**

#### Welcome and introduction

Welcome by **Tim Robinson**, Senior Manager: Workshops, EWEA

Introduction to the workshop by **Oisín Brady**, Director, Natural Power, France

#### Session One: Data from operating assets: what are they really worth?

This session focused on the following issues:

- What data come from an operating wind farm and what use are they?
- A comparison of actual pre- and post-construction data
- Verification of pre-construction loss factors, post construction. How should this be done and what is feasible from the available data?
- Impact of changing warranty contract structure from time availability to energy availability.

*Session chair:* **Scott MacKenzie**, Associate Director - Asset Management, Natural Power Consultants, UK

Introduction to the session

Chair

The needs of investors for confidence in wind farms to operate as expected

**Tom Cronin**, Special Advisor, DTU Wind Energy, Denmark

Warranty operating issues, experience and lessons learnt

**Chris Smith**, Technical Contracting (O&M), E.ON Climate and Renewables, Germany

Questions and answers and debate with participants

## Session Two: Post-construction yield analysis techniques

Following the success of the ‘Comparison of Resource and Energy Yield Assessment Procedures’ at the EWEA Wind Resource Assessment Technology Workshop (May 2011), this session gauged the level of industry consensus on methods for predicting the long-term energy yield of operating wind farms.

The key aims of this session were to establish the state-of-the-art as it currently stands and debate the path that the industry should be taking with respect to long-term production forecasting.

In order to provide a thorough cross-section of opinion on post-construction yield analysis techniques, a comprehensive survey was distributed to stakeholders throughout the industry prior to the event (open from 15 May - 15 June), covering key topics including:

- Definition of long-term wind trends;
- Mission critical SCADA tests;
- Availability - defining and taking account of downtime losses;
- Power curve analysis; rationale, techniques;
- Correlations techniques; any advance on traditional MCP (measure, correlate, predict)?
- Uncertainties;
- The future of production yield forecasting.

The results of this survey were presented in detail at the event followed by a panel discussion with experienced wind engineers, designed to highlight key areas of agreement and disagreement. This kicked off an open floor debate that allowed everyone to voice their opinion on state of the art techniques and where the future lies.

*Session chair:* **Andrew Strachan**, Senior Engineer, Asset Management and Optimisation Services, GL Garrad Hassan, UK

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| Introduction to the session  | Chair  |
| Results of the pre-workshop survey of post-construction yield analysis techniques  | <b>Luc Rademakers</b> , Senior Manager Wind Energy Systems, ECN, The Netherlands |
| Debate with the panellists and audience.   |  |
| Panellists:  |  |
| <ul style="list-style-type: none"><li>• <b>Kai Mönnich</b>, Head of Micrositing International, DEWI GmbH, Germany</li><li>• <b>Jessica Cameron</b>, Asset Analyst, Natural Power Consultants, UK</li></ul> |  |

### Session three: Power performance

Wind turbine power curve tests according to current standards come with considerable effort and many practical hurdles. Thus, a key issue for wind farm operators is: do power curve tests pay off? Are they a viable way to verify warranted power curves or to optimise power curves, for example? Another frequently asked question is: how can the effort required for qualified power curve testing be reduced? This is especially relevant offshore, where installing a meteorological mast is often barely feasible.

These topics were addressed by presentations from leading experts from independent testing laboratories and turbine suppliers. Key lessons to be learned are:

- How likely are warranted power curves to be met, and what are the typical drivers for underperformance?
- Does testing of exemplary turbines in a wind farm make sense?
- Is testing of a power curve once in the lifetime of a turbine sufficient or useful?
- Are today's power curve warranties fair, e.g. in terms of limitations of the validity of warranted power curves, specifications of the testing procedure, criteria of fulfilment of the warranty, compensation rules?
- Should a warranted power curve be of generic nature or site-specific?
- How can a generic power curve be adjusted to site-specific conditions for wind resource assessments?
- What are the possibilities and limitations of advanced nacelle anemometry as a more cost-effective procedure for power curve testing?
- What is expected from using nacelle based LiDARS or scanning LiDARS for power curve testing?

Some of the presented subjects are highly controversial as there is potentially a conflict of interest between turbine operators and turbine suppliers regarding to power curve warranties. This provided the basis for an active discussion of industry participants after the presentations.

*Session chair:* **Axel Albers**, Managing Director, Deutsche WindGuard GmbH, Germany

Introduction to the session

Power Performance Testing: Truly useful of just box ticking?

How appropriate are sales power curves on complex or forested sites?

Advanced nacelle anemometry and SCADA-data, analysis techniques and limitations

Nacelle based LiDARS and scanning LiDARS, of particular relevance in offshore locations

Questions and answers and debate with participants

Chair

**Mark Young**, Head of Department, Cleaner Energy, DNV KEMA Energy & Sustainability, UK

**Tomas Blodau**, Team Leader Wind and Site, REpower, Germany

**Frank Ormel**, Chief Specialist Product Performance, Vestas, Denmark

**Rozenn Wagner**, DTU Wind Energy, Denmark

**Tuesday 3 July 2012**

**Session Four: Availability and asset monitoring**

This session focused on the following issues:

- Calculating and categorising downtime;
- Key performance indicators; downtime, production losses, energy-based availability;
- Monitoring assets by defining normal behaviour and comparing to actual behaviour – Methods and benefits;
- What level of availability can be expected post-warranty?
- How is availability assessed? Is downtime equivalent to energy loss?
- IEC 61400-26 standard – what is it? How can it be used effectively?
- Movement towards yield-based guarantees: who does this benefit?
- Balance of Plant (BoP) and grid availability.

*Session chair:* **Javier García Gonzalez-Quijano**, Head of Asset Performance Analysis and Commercial Operation Tools Department, Iberdrola Renovables, Spain

Introduction to the session

Key performance indicators: energy-based availability vs. time-based availability. Pros, cons and results expected.

Categorizing downtimes and calculating downtime and production losses. Best practice and cost-benefit.

IEC 61400-26 Standard: what is it and how can it be used effectively?

Future contract guarantees and yield based guarantees: methodologies and who benefits?

Questions and answers and debate with participants

Chair

**Jose Carlos Araujo Martin**, Asset Performance Analysis and Commercial Operations Tools, Iberdrola Renovables, Spain

**Teresa Santonato**, Responsible for Analysis and Support, EREDA, Spain

**Harald Decker**, Member – PT26 Working Group, Technical Committee 88 - Wind turbines, IEC - International Electrotechnical Commission, Switzerland

**Kasper Van Lombeek**, Operations and Maintenance Engineer, Belwind nv, Belgium

## Session Five: Turbine by turbine performance

This session focused on the following issues:

- How do operational costs vary across sites?
- Bad behaviour: does each turbine perform as it should on paper?
- Yaw and pitch misalignment and wider aspect of nearest neighbour analysis;
- Use of non- SCADA data: work control, power quality monitoring, reference wind data;
- Interesting trends to look at using the available SCADA data.

*Session chair:* **Mike Anderson**, Group Technical Director, RES - Renewable Energy Systems Ltd, UK

Introduction to the session

Why does T7 underperform? Individual turbine performance relative to preconstruction estimates.

Findings of investigations into underperforming sites

Using remote sensing to better understand operational performance

How does the real world performance of wind turbines compare with sales power curves?

Questions and answers and debate with participants

Workshop conclusion

Chair

**Peter Stuart**, Technical Analyst, RES - Renewable Energy Systems Ltd, UK

**Michael C. Brower**, Principal and Chief Technical Officer, AWS Truepower, USA

**Richard Boddington**, Director of Measurement and Analysis, SgurrEnergy Ltd, UK

**Keir Harman**, Head of Asset Management and Optimisation Services, GL Garrad Hassan, UK